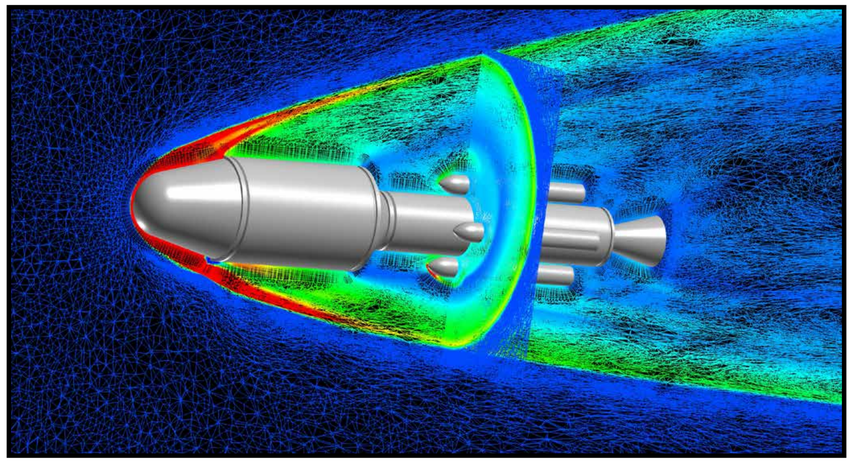
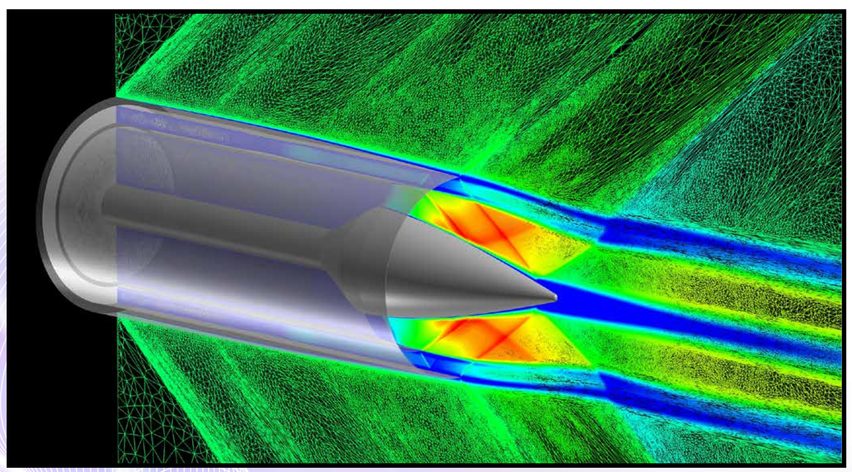
National Aeronautics and Space Administration

AERONAUTICS

High-Fidelity Analysis and Design for Complex Aerospace Configurations



Mesh adaptation for FUN3D simulations of the Mars Ascent Vehicle, with the flow field colored by pressure. *Ashley Korzun, NASA/Langley*



Simulation of the internal/external engine nozzle flow field for a supersonic vehicle. Color scale shows the flow field Mach number. *Chris Heath, NASA/Glenn*

FUN3D is an unstructured-grid computational fluid dynamics simulation suite used to tackle NASA's most complex aerodynamics problems. The toolset offers multidisciplinary analysis capabilities, incorporating models for structural effects, multi-body dynamics, acoustics, radiation, and ablation. FUN3D provides the world's foremost adjoint-based design capability, enabling optimization of general, time-dependent, moving-body simulations involving turbulent flows, rigorous mesh adaptation, and error estimation. FUN3D is widely used to support major national research and engineering efforts, both within NASA and among groups across U.S. industry, the Department of Defense, and academia. Key applications that FUN3D currently supports include:

- NASA aeronautics research, spanning fixed-wing vehicles, rotary-wing vehicles, and supersonic boom mitigation.
- Design and analysis of launch vehicles and re-entry deceleration concepts for NASA's space missions.
- Development of commercial crew spacecraft at companies such as SpaceX.
- Timely analysis of vehicles and weapons systems for U.S. military efforts around the world.
- Efficient green energy concept development, such as wind turbine design and drag minimization for long-haul trucking.

A past FUN3D collaboration with the Department of Energy received the prestigious Gordon Bell Prize for outstanding achievements in high-performance computing. FUN3D has been successfully scaled to 80,000 cores for computational grids containing billions of elements.

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